



# The effect of periodontal and prosthodontic therapy on glycemic control in patients with diabetes

Hak-Ki Kim<sup>1</sup>, Yong-Gun Kim<sup>1</sup>, Jin-Hyun Cho<sup>2</sup>, Sang-Kyu Lee<sup>3\*</sup>, Jae-Mok Lee<sup>1\*</sup>

<sup>1</sup>Department of Periodontology, Kyungpook National University School of Dentistry, Daegu, Republic of Korea

<sup>2</sup>Department of Prosthodontics, Kyungpook National University School of Dentistry, Daegu, Republic of Korea

<sup>3</sup>College of Pharmacy and Research Institute of Pharmaceutical Sciences, Kyungpook National University, Daegu, Republic of Korea

**PURPOSE.** To evaluate the effect of periodontal and prosthodontic therapy on glycated hemoglobin A(HbA1c) level in patients with diabetes. **MATERIALS AND METHODS.** This is a retrospective study of 70 patients suffering from diabetes who visited the Kyungpook National University Hospital between January 2016 and May 2018. Patients underwent medical evaluation for their routine check-up, which includes laboratory test for HbA1c levels. Among the 70 patients, 35 patients also visited Kyungpook National University Dental Hospital during the same period to receive periodontal and prosthodontic therapy, while the other 35 patients did not receive such therapy. The HbA1c levels were compared before and after periodontal and prosthodontic therapy. Comparisons between groups and within groups were performed using independent t-test. **RESULTS.** The HbA1c levels in the group who have received periodontal and prosthodontic therapy decreased from 7.2 to 6.7 ( $P=.001$ ). The HbA1c levels in the control group decreased from 7.2 to 7.1 ( $P=.580$ ). The difference in changes between the two patient groups was statistically significant ( $P=.011$ ). **CONCLUSION.** Periodontal and prosthodontic therapy can be effective on glycemic control in patients with diabetes. [J Adv Prosthodont 2019;11:247-52]

**KEYWORDS:** Diabetes mellitus; Glycated hemoglobin A; Periodontal diseases; Prosthodontics

## INTRODUCTION

Diabetes mellitus and periodontal disease are two common diseases that are in close relation to one another.<sup>1</sup> Diabetes mellitus alters glucose tolerance or impairs metabolism of lipids and carbohydrates.<sup>2</sup> It is considered as a manifestation of a persistent chronic low-grade inflammation.<sup>3</sup> Periodontal disease is a chronic inflammatory condition that causes an

imbalance in anabolic and catabolic processes, ultimately resulting in resorption of alveolar bone or tooth-supporting tissues.<sup>4</sup>

Previous clinical studies<sup>5,6</sup> provided evidence on a mutual relationship between diabetes mellitus and periodontal disease. In diabetes, hyperglycemia is a potential risk factor for periodontitis.<sup>7-9</sup> In periodontitis, a systematic review by Borgnakke *et al.*<sup>10</sup> suggested that severe periodontitis was related to significantly elevated serum levels of HbA1c.

Previous research<sup>1</sup> has given effort to clarify the underlying mechanisms between diabetes mellitus and periodontal disease. Gingival crevicular fluid is a serum transudate originating from the gingival plexus of blood vessels.<sup>11</sup> It has been shown that elevated serum levels of inflammatory mediators and cytokines such as tumor necrosis factor-alpha (TNF- $\alpha$ ) in diabetic patients correlated with increased levels of these mediators and cytokines in gingival crevicular fluid.<sup>12</sup> Systemic infection of gram negative organisms such as *Porphyromonas gingivalis*, *Tannerella forsythensis*, *Prevotella intermedia* or their products may promote an elevated inflammatory state and increased levels of serum inflammatory markers.<sup>13</sup> Serum markers of inflammation such as C-reactive protein (CRP), IL-6, and fibrinogen are significantly higher in

Corresponding author:

Jae-Mok Lee

Department of Periodontology, Kyungpook National University School of Dentistry, 2177 Dalgubeol-daero, Jung-gu, Daegu 41566, Republic of Korea  
Tel. +82536007522; e-mail, leejm@knu.ac.kr

Sang-Kyu Lee

College of Pharmacy and Research Institute of Pharmaceutical Sciences, Kyungpook National University, Daehak-ro 80, Buk-gu, Daegu 41566, Republic of Korea

Tel. +82539508571; e-mail, sangkyu@knu.ac.kr

Received February 27, 2019 / Last Revision October 29, 2019 / Accepted October 30, 2019

© 2019 The Korean Academy of Prosthodontics

This is an Open Access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (<http://creativecommons.org/licenses/by-nc/4.0>) which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

patients with periodontitis, than in patients without periodontitis.<sup>14-16</sup> Gram-negative infections in periodontal disease may also engender insulin resistance and exacerbate metabolic control in patients with diabetes.<sup>17</sup>

In view of these relations between diabetes mellitus and periodontal disease, it has been speculated that treatment of periodontal diseases can improve metabolic control of diabetes.<sup>18</sup> According to previous studies,<sup>19,20</sup> the magnitude of the reduction in HbA1c ranged from 0.27% to 0.48% 3 - 4 months after periodontal treatment. Despite periodontal treatment seeming to ameliorate metabolic control, evidence was not sufficient to significantly associate periodontal treatment and metabolic control in patients with diabetes.<sup>21</sup> According to a consensus report, there is a lack of data to manifest that this effect is maintained over 6 months following periodontal treatment.<sup>22</sup>

Prosthodontic therapy, such as restoration, implant prosthesis, and removable partial denture, have been reported to cause dental problems on abutment teeth.<sup>23</sup> Plaques can be accumulated on teeth used as abutment, thus becoming a risk for infection and deteriorate metabolic control for patients with diabetes. However, there was not enough evidence to conclude whether these changes on abutment teeth could be mitigated when periodontal therapy was combined.

Therefore, in this retrospective study, we sought to compare the changes in glycemic control between patients receiving periodontal and prosthodontic therapy and patients not receiving the therapy over 6 month period.

## MATERIALS AND METHODS

70 diabetic patients who visited the Kyungpook National University Hospital to monitor their HbA1c levels between January 2016 and May 2018 were analyzed in this study. Among the 70 patients, 35 patients who also visited Kyungpook National University Dental Hospital to receive periodontal and prosthodontic therapy during the same period was designated as the treatment group, and the other 35 patients who did not received such therapy was designated as the control group.

The treatment group was further divided to subgroups according to the type of periodontal therapy: active periodontal therapy and supportive periodontal therapy. The

treatment group was also classified based on whether prosthodontic therapy was carried out or not (with or without prosthodontic therapy). Active periodontal therapy encompassed oral hygiene instruction, full mouth scaling, subgingival curettage, extraction and flap operation performed under local anesthesia. Supportive periodontal therapy consisted of oral hygiene instructions, full mouth scaling, and root planing. The mean interval between visits for supportive periodontal therapy was 3.5 months. Prosthodontic therapy consisted of implant prosthodontics, single and bridge restorations, occlusal adjustment, and removable partial denture. Patients in the treatment group received at least one of these therapies.

In the treatment group, data such as the type of periodontal therapy, the presence or absence of prosthodontic therapy, and the number of teeth lost, were collected. The number of teeth lost was calculated by subtracting the number of remaining teeth from 32 teeth.

A statistical analysis was performed using a SPSS software (IBM SPSS Statistics for Windows, Version 23.0. IBM, Armonk, NY, USA). Comparison of HbA1c levels before and after therapy within groups, and difference in extent of HbA1c reduction between groups were performed using independent t-test. Correlation between level of HbA1c before therapy and the number of teeth lost was investigated through simple linear regression analysis. It was considered to be statistically significant when *P* value is below 0.05.

## RESULTS

Clinical characteristics are summarized in Table 1. At baseline, the two groups had similar mean values for age, gender distribution, and the time interval between the initial and final HbA1c levels.

The HbA1c levels in the treatment group decreased from 7.2 to 6.7 (*P* = .001) following periodontal and prosthodontic therapy, and this change was statistically significant (Fig. 1). During the similar time frame, the HbA1c levels in the control group also decreased from 7.2 to 7.1 (*P* = .580) but this change was not statistically significant. Furthermore, the difference in changes between the two groups was statistically significant (*P* = .011, Fig. 1).

Clinical characteristics of two subcategories of the treat-

**Table 1.** Clinical characteristics of patients of treatment and control groups

		Group (n = 70)			
		TG <sup>a</sup> (n = 35)		CG <sup>b</sup> (n = 35)	
		N <sup>c</sup> (%)	M ± SD <sup>d</sup>	N <sup>c</sup> (%)	M ± SD <sup>d</sup>
Age (years)			60.7 ± 11.2		60.7 ± 10.5
Interval of time at initial and final HbA1c time (months)			13.1 ± 5.1		13.1 ± 3.9
Gender	Male	19 (54.3%)		19 (54.3%)	
	Female	16 (45.7%)		16 (45.7%)	

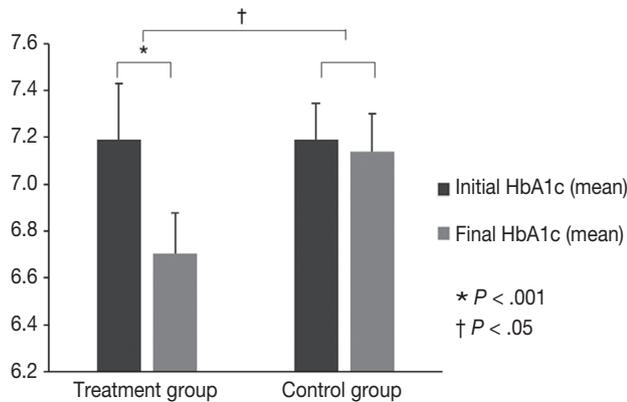
<sup>a</sup> Treatment group, <sup>b</sup> Control group, <sup>c</sup> Number of patients, <sup>d</sup> Mean ± standard deviation.

ment group according to the type of periodontal therapy are summarized in Table 2. The two groups were well matched for age, gender distribution, and the time interval between the initial and final HbA1c levels. The only statistical difference between the two groups was the mean interval of therapy; the mean interval of active periodontal therapy group was  $1.6 \pm 0.7$  months, whereas that of supportive periodontal therapy group was  $3.5 \pm 0.5$  months.

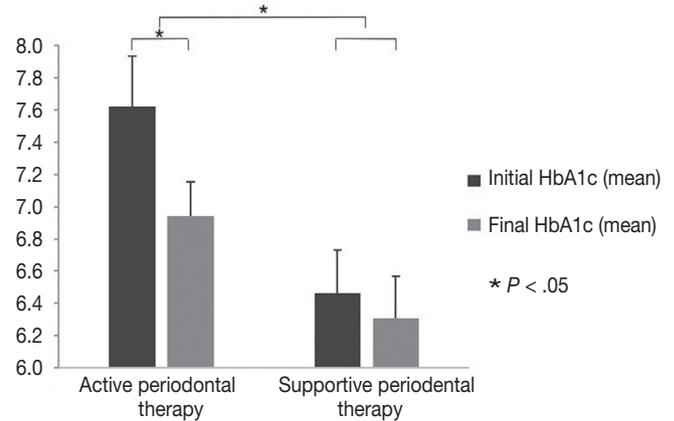
The HbA1c levels in the active periodontal therapy group decreased from 7.6 to 6.9 ( $P = .003$ ), and this change was statistically significant (Fig. 2). During a similar time frame, the HbA1c levels in the supportive periodontal

therapy group also decreased from 6.5 to 6.3 ( $P = .194$ ), but this change was not statistically significant. Furthermore, the difference in changes between the two groups was statistically significant ( $P = .029$ , Fig. 2). The initial HbA1c level of the active periodontal therapy group and supportive periodontal therapy group was 7.6 and 6.5, respectively, and this difference was statistically significant ( $P = .016$ ).

Clinical characteristics of two subcategories of the treatment group based on whether or not prosthodontic therapy was carried (with or without prosthodontic therapy) were summarized in Table 3. The two groups differed in age, gender distribution, and the time interval between the initial and



**Fig. 1.** Comparison of HbA1c reduction between treatment and control group before and after therapy.



**Fig. 2.** Comparison of HbA1c reduction between active and supportive periodontal group before and after therapy.

**Table 2.** Clinical characteristics of two subcategories of the treatment group according to the type of periodontal therapy

	Treatment group				P value
	Active periodontal therapy		Supportive periodontal therapy		
	N <sup>a</sup> (%)	M ± SD <sup>b</sup>	N <sup>a</sup> (%)	M ± SD <sup>b</sup>	
Age (years)		62.1 ± 12.5		58.4 ± 8.3	.350
Interval of time at initial and final HbA1c time (months)		13.3 ± 5.2		12.8 ± 5.2	.780
The mean interval of therapy (months)		1.6 ± 0.7		3.5 ± 0.5	.000*
Gender	Male	11 (50.0%)		8 (61.5%)	.508
	Female	11 (50.0%)		5 (38.5%)	

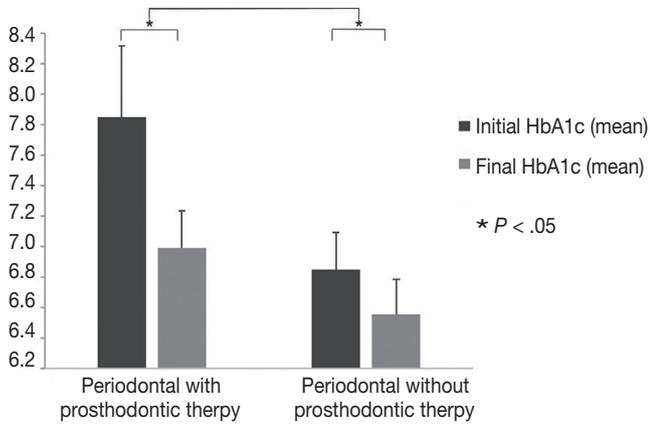
\* Significant difference at the 0.05 level.

<sup>a</sup> Number of patients, <sup>b</sup> Mean ± standard deviation.

**Table 3.** Clinical characteristics of two subcategories of the treatment group based on whether prosthodontic therapy was carried out or not (with or without prosthodontic therapy)

	Treatment group				P value
	Periodontal with prosthodontic therapy		Periodontal without prosthodontic therapy		
	N <sup>a</sup> (%)	M ± SD <sup>b</sup>	N <sup>a</sup> (%)	M ± SD <sup>b</sup>	
Age (years)		64.1 ± 8.5		59.0 ± 12.2	.201
Interval of time at initial and final HbA1c time (months)		12.6 ± 5.5		13.3 ± 5.0	.680
Gender	Male	5 (41.7%)		14 (60.9%)	.279
	Female	7 (58.3%)		9 (39.1%)	

<sup>a</sup> Number of patients, <sup>b</sup> Mean ± standard deviation.



**Fig. 3.** Comparison of HbA1c reduction between periodontal with prosthodontic and periodontal without prosthodontic group before and after therapy.

final HbA1c levels, but this difference was not statistically significant.

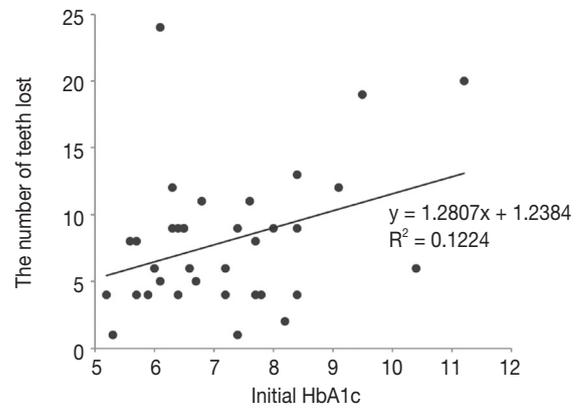
The HbA1c levels in the periodontal with prosthodontic therapy group decreased from 7.9 to 7.0 ( $P = .025$ ), and this change was statistically significant (Fig. 3). During a similar time frame, the HbA1c levels in the periodontal without prosthodontic therapy group also decreased from 6.8 to 6.6 ( $P = .014$ ), and this change was statistically significant (Fig. 3). However, the difference in changes between the two groups was not statistically significant.

The simple linear regression model showed that there was a positive correlation between initial HbA1c and the number of teeth loss in the treatment group, which was statistically significant ( $P = .039$ , Fig. 4).

## DISCUSSION

There were previously published studies<sup>24-26</sup> investigating the relationship between periodontal therapy and HbA1c levels. Moeintaghavi *et al.*<sup>27</sup> noted a significant reduction of HbA1c level (0.74%) in the treatment group after 3 months. Sun *et al.*<sup>28</sup> also observed a reduction of HbA1c level (0.5%) in the treatment group after 3 months. Our results supported those of previous studies, showing a reduction of HbA1c level from 7.2 to 6.7 (0.5%) after periodontal and prosthodontic therapy.

The mechanism by which HbA1c decreases after periodontal and prosthodontic therapy can be explained by the regulation of TNF-alpha (Tumor Necrosis Factor-alpha) levels. In diabetic patients, elevated levels of TNF-alpha can engender insulin resistance and worsen glycemic control<sup>2</sup>. Therefore, in diabetic patients, decreasing TNF-alpha levels through periodontal and prosthetic therapy can restore insulin sensitivity and improve glycemic control. In a study<sup>29</sup> of 13 type 2 diabetic subjects with periodontitis, periodontal therapy decreased TNF-alpha levels. In another study<sup>30</sup> using rat model, the expression of interleukin-1beta, cyclo-



**Fig. 4.** Simple linear regression analysis showing the correlation between level of HbA1c before therapy and the number of teeth lost.

oxygenase 2, and TNF-alpha tended to be elevated by trauma from occlusion, and thereby occlusal stabilization through prosthodontic therapy was expected to decrease TNF-alpha levels.

Recent randomized clinical trial<sup>27</sup> examined the effect of periodontal treatment on the glycemic control and showed a reduction in HbA1c after 3 to 4 months of follow-up. There are insufficient data to show that this effect is maintained after 6 months or more.<sup>5</sup> Within the limitation of retrospective study, we found a significant reduction in the HbA1c level (0.5%) in the treatment group after 13.1 months in average.

We noticed that active periodontal therapy was more effective in reducing HbA1c level than supportive periodontal therapy. This result could be due to the difference in mean interval of therapy. Active periodontal therapy had much shorter time interval than supportive periodontal therapy. We also noticed that the initial HbA1c level of supportive periodontal therapy group was much lower than that of active periodontal therapy group. Supportive periodontal therapy group had already been treated with active periodontal therapy before the initiation of supportive periodontal therapy, thus having lower initial HbA1c level from the beginning.

Prosthodontic therapy such as implant prosthesis, restoration, and removable partial denture could change the ecological system of the oral cavity possibly raising plaque accumulation at teeth.<sup>31</sup> This could lead to bacteremia in the oral cavity and could exacerbate metabolic in diabetic patients. However, our results showed that periodontal and prosthodontic therapy group showed significant reduction in the HbA1c level, even more than periodontal therapy alone. This indicated that when periodontal therapy was performed together, prosthodontic therapy did not worsen glycemic control in patients with diabetes.

Polak and Shapira<sup>32</sup> suggested a biological pathway that the elevated pro-inflammatory factors in the gingiva of

patients with poorly controlled serum glucose may aggravate periodontitis. In this study, we examined the relationship between initial HbA1c and teeth loss rates in treatment group. Our study showed positive correlation between initial HbA1c and teeth loss rates and this result was statistically significant. This indicates that the severity of diabetes may affect the progression of periodontitis.

The retrospective design of this study presents inherent limitations. Not all HbA1c levels of patients were measured at the same time after periodontal and prosthodontic therapy. Another limitation is the inability to examine TNF-alpha levels after periodontal and prosthodontic treatment. Further studies are needed to examine TNF-alpha and C-Reactive Protein levels after periodontal and prosthetic treatment through randomized controlled design.

## CONCLUSION

There is strong evidence for an association between diabetes mellitus and periodontal disease. Diabetes mellitus increases the risk of periodontitis, and periodontal and prosthodontic therapy improves glycemic control.

## ORCID

Hak-Ki Kim <https://orcid.org/0000-0002-1597-1518>

Yong-Gun Kim <https://orcid.org/0000-0002-2793-7667>

Jin-Hyun Cho <https://orcid.org/0000-0002-2453-9372>

Sang-Kyu Lee <https://orcid.org/0000-0002-7568-2902>

Jae-Mok Lee <https://orcid.org/0000-0002-0291-6114>

## REFERENCES

- Sonnenschein SK, Meyle J. Local inflammatory reactions in patients with diabetes and periodontitis. *Periodontol* 2000;69:221-54.
- Mealey B. Diabetes and periodontal diseases. *J Periodontol* 1999;70:935-49.
- Xie W, Du L. Diabetes is an inflammatory disease: evidence from traditional Chinese medicines. *Diabetes Obes Metab* 2011;13:289-301.
- Taiyeb-Ali TB, Raman RP, Vaithilingam RD. Relationship between periodontal disease and diabetes mellitus: an Asian perspective. *Periodontol* 2000;56:258-68.
- Chávarry NG, Vettore MV, Sansone C, Sheiham A. The relationship between diabetes mellitus and destructive periodontal disease: a meta-analysis. *Oral Health Prev Dent* 2009;7:107-27.
- Lalla E, Papananou PN. Diabetes mellitus and periodontitis: a tale of two common interrelated diseases. *Nat Rev Endocrinol* 2011;7:738-48.
- Emrich LJ, Shlossman M, Genco RJ. Periodontal disease in non-insulin-dependent diabetes mellitus. *J Periodontol* 1991;62:123-31.
- Lalla E, Cheng B, Lal S, Tucker S, Greenberg E, Goland R, Lamster IB. Periodontal changes in children and adolescents with diabetes: a case-control study. *Diabetes Care* 2006;29:295-9.
- Taylor GW, Burt BA, Becker MP, Genco RJ, Shlossman M, Knowler WC, Pettitt DJ. Non-insulin dependent diabetes mellitus and alveolar bone loss progression over 2 years. *J Periodontol* 1998;69:76-83.
- Borgnakke WS, Ylöstalo PV, Taylor GW, Genco RJ. Effect of periodontal disease on diabetes: systematic review of epidemiologic observational evidence. *J Clin Periodontol* 2013;40:S135-52.
- Barros SP, Williams R, Offenbacher S, Morelli T. Gingival crevicular fluid as a source of biomarkers for periodontitis. *Periodontol* 2000;70:53-64.
- Salvi GE, Yalda B, Collins JG, Jones BH, Smith FW, Arnold RR, Offenbacher S. Inflammatory mediator response as a potential risk marker for periodontal diseases in insulin-dependent diabetes mellitus patients. *J Periodontol* 1997;68:127-35.
- Wu T, Trevisan M, Genco RJ, Falkner KL, Dorn JP, Sempos CT. Examination of the relation between periodontal health status and cardiovascular risk factors: serum total and high density lipoprotein cholesterol, C-reactive protein, and plasma fibrinogen. *Am J Epidemiol* 2000;151:273-82.
- Naguib G, Al-Mashat H, Desta T, Graves DT. Diabetes prolongs the inflammatory response to a bacterial stimulus through cytokine dysregulation. *J Invest Dermatol* 2004;123:87-92.
- Noack B, Genco RJ, Trevisan M, Grossi S, Zambon JJ, De Nardin E. Periodontal infections contribute to elevated systemic C-reactive protein level. *J Periodontol* 2001;72:1221-7.
- Loos BG, Craandijk J, Hoek FJ, Wertheim-van Dillen PM, van der Velden U. Elevation of systemic markers related to cardiovascular diseases in the peripheral blood of periodontitis patients. *J Periodontol* 2000;71:1528-34.
- Mealey BL, Oates TW; American Academy of Periodontology. Diabetes mellitus and periodontal diseases. *J Periodontol* 2006;77:1289-303.
- Stewart JE, Wager KA, Friedlander AH, Zadeh HH. The effect of periodontal treatment on glycemic control in patients with type 2 diabetes mellitus. *J Clin Periodontol* 2001;28:306-10.
- Li Q, Hao S, Fang J, Xie J, Kong XH, Yang JX. Effect of non-surgical periodontal treatment on glycemic control of patients with diabetes: a meta-analysis of randomized controlled trials. *Trials* 2015;16:291.
- Teshome A, Yitayeh A. The effect of periodontal therapy on glycemic control and fasting plasma glucose level in type 2 diabetic patients: systematic review and meta-analysis. *BMC Oral Health*. 2016;17:31.
- Mauri-Obradors E, Merlos A, Estrugo-Devesa A, Jané-Salas E, López-López J, Viñas M. Benefits of non-surgical periodontal treatment in patients with type 2 diabetes mellitus and chronic periodontitis: A randomized controlled trial. *J Clin Periodontol* 2018;45:345-53.
- Sanz M, Ceriello A, Buysschaert M, Chapple I, Demmer RT, Graziani F, Herrera D, Jepsen S, Lione L, Madianos P, Mathur M, Montanya E, Shapira L, Tonetti M, Vegh D. Scientific evidence on the links between periodontal diseases and diabetes: Consensus report and guidelines of the joint workshop on periodontal diseases and diabetes by the International Diabetes Federation and the European Federation of Periodontology. *J*

- Clin Periodontol 2018;45:138-49.
23. Pretzl B, Kaltschmitt J, Kim TS, Reitmeir P, Eickholz P. Tooth loss after active periodontal therapy. 2: tooth-related factors. J Clin Periodontol 2008;35:175-82.
  24. Madianos PN, Koromantzos PA. An update of the evidence on the potential impact of periodontal therapy on diabetes outcomes. J Clin Periodontol 2018;45:188-95.
  25. Mauri-Obradors E, Jané-Salas E, Sabater-Recolons Mdel M, Vinas M, López-López J. Effect of nonsurgical periodontal treatment on glycosylated hemoglobin in diabetic patients: a systematic review. Odontology 2015;103:301-13.
  26. Wang TF, Jen IA, Chou C, Lei YP. Effects of periodontal therapy on metabolic control in patients with type 2 diabetes mellitus and periodontal disease: a meta-analysis. Medicine (Baltimore) 2014;93:e292.
  27. Moeintaghavi A, Arab HR, Bozorgnia Y, Kianoush K, Alizadeh M. Non-surgical periodontal therapy affects metabolic control in diabetics: a randomized controlled clinical trial. Aust Dent J 2012;57:31-7.
  28. Sun WL, Chen LL, Zhang SZ, Wu YM, Ren YZ, Qin GM. Inflammatory cytokines, adiponectin, insulin resistance and metabolic control after periodontal intervention in patients with type 2 diabetes and chronic periodontitis. Intern Med. 2011;50:1569-74.
  29. Iwamoto Y, Nishimura F, Nakagawa M, Sugimoto H, Shikata K, Makino H, Fukuda T, Tsuji T, Iwamoto M, Murayama Y. The effect of antimicrobial periodontal treatment on circulating tumor necrosis factor-alpha and glycated hemoglobin level in patients with type 2 diabetes. J Periodontol 2001;72:774-8.
  30. Matsuda Y, Minagawa T, Okui T, Yamazaki K. Resveratrol suppresses the alveolar bone resorption induced by artificial trauma from occlusion in mice. Oral Dis 2018;24:412-21.
  31. Müller S, Eickholz P, Reitmeir P, Eger T. Long-term tooth loss in periodontally compromised but treated patients according to the type of prosthodontic treatment. A retrospective study. J Oral Rehabil 2013;40:358-67.
  32. Polak D, Shapira L. An update on the evidence for pathogenic mechanisms that may link periodontitis and diabetes. J Clin Periodontol 2018;45:150-66.